

Title: Assessment of exposure to airborne ultrafine particles in the urban environment of Lisbon, Portugal

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Abstract: The aim of this study was the assessment of exposure to ultrafine in the urban environment of Lisbon, Portugal, due to automobile traffic, and consisted of the determination of deposited alveolar surface area in an avenue leading to the town center during late spring. This study revealed differentiated patterns for weekdays and weekends, which could be related with the fluxes of automobile traffic. During a typical week, ultrafine particles alveolar deposited surface area varied between 35.0 and 89.2 $\mu\text{m}^2/\text{cm}^3$, which is comparable with levels reported for other towns such in Germany and the United States. These measurements were also complemented by measuring the electrical mobility diameter (varying from 18.3 to 128.3 nm) and number of particles that showed higher values than those previously reported for Madrid and Brisbane. Also, electron microscopy showed that the collected particles were composed of carbonaceous agglomerates, typical of particles emitted by the exhaustion of diesel vehicles.

Implications: The approach of this study considers the measurement of surface deposited alveolar area of particles in the outdoor urban environment of Lisbon, Portugal. This type of measurements has not been done so far. Only particulate matter with aerodynamic diameters <2.5 (PM_{2.5}) and >10 (PM₁₀) μm have been measured in outdoor environments and the levels found cannot be found responsible for all the observed health effects. Therefore, the exposure to nano- and ultrafine particles has not been assessed systematically, and several authors consider this as a real knowledge gap and claim for data such as these that will allow for deriving better and more comprehensive epidemiologic studies. Nanoparticle surface area monitor (NSAM) equipments are recent ones and their use has been limited to indoor atmospheres. However, as this study shows, NSAM is a very powerful tool for outdoor environments also. As most lung diseases are, in fact, related to deposition of the alveolar region of the lung, the metric used in this study is the ideal one.

KeyWords Plus: Surface-Area; Pollution; Air

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